

## Meeting the Needs of the 21<sup>st</sup> Century

### Background

There are many issues surrounding the development of the scientific workforce in the 21<sup>st</sup> Century. As the authors of a recent report by the National Research Council observed, the training and career prospects of a graduate student or postdoctoral fellow in the life sciences in 1998 are very different from what they were in the 1960s or 1970s. The average life scientist is likely to be 35 or 40 years old before entering the "first job" after a lengthy period of training. As the authors of the NRC report observed: "The continued success of the life-science research enterprise depends on the uninterrupted entry into the field of well-trained, skilled and motivated young people. For this critical flow to be guaranteed, young aspirants must see that there are exciting challenges ahead and they need to believe that they have a reasonable likelihood of becoming practicing independent scientists after their long years of training to prepare for their careers".<sup>13</sup>

In addition to changing patterns of education and training, changes are taking place in the structure of the entire American health care system. For example, the principal performers of health research -- academic health centers (AHCs), the pharmaceutical industry, and managed care organizations -- are all evolving. Changes in those sectors are having a direct impact on career formation in the health sciences.

A recent report issued by the Burroughs-Wellcome Fund<sup>14</sup> provides evidence that these dramatic improvements in health care have resulted in numerous changes in the academic environment. For example, physician scientists at AHCs are under increasing pressure to deliver health care to generate revenue, thereby "impeding their ability to establish and sustain research careers".<sup>15</sup>

As faculty adjust to these changing employment conditions, other concerns emerge. Questions arise about their availability to serve as mentors to upcoming health scientists. Faculty roles are also jeopardized as scientific role models.

In 1995, Harold Varmus, director of the National Institutes of Health, commissioned a Panel on Clinical Research to define the problems and offer solutions in this area. In addition to the topics mentioned in the foregoing paragraphs, the authors of the 1997 Clinical Research Report<sup>16</sup> noted other problems impeding the recruitment of clinical scientists. Chief among these was the "high level of debt" which graduates have accrued during the course of their clinical training as well as student perceptions about careers in clinical research.

<sup>13</sup> NRC, *Trends in the Early Careers of Life Scientists*, Washington, DC: National Academy Press, 1998.

<sup>14</sup> Burroughs-Wellcome Fund, *Strengthening Health Research in America: Philanthropy's Role*, with the American Cancer Society, Howard Hughes Medical Institute, and The Pew Charitable Trust. <http://www.pewtrusts.com>.

<sup>15</sup> Ibid.

<sup>16</sup> NIH, December 1997, *op. cit.*

A number of authors have explored the matter of how academic health centers will be able to accommodate the drastic changes that are occurring in the “economic and organizational aspects” of clinical medicine. But as Jeffrey Gordon and David Kipnis<sup>17</sup> suggest: “...it is important to use our energies to undertake a creative and proactive assessment of the challenges and opportunities that these changes offer, rather than to adopt a reactive and constrictive posture that has as its goal identifying or anticipating as many of the consequences of change as possible.”

A number of professional organizations have begun to respond to the opportunities and challenges in the sciences and they have done so by developing some unique strategies. To understand some of the emerging efforts, meeting organizers invited a number of experts to describe their experiences to the NIDCR Blue Ribbon Panel. The sections that follow provide highlights of their testimony. An edited summary of each presentation is found in Appendix A.

## The National Institutes of Health

Meeting organizers invited three speakers to brief the Blue Ribbon Panel on issues and developments in the recruitment and retention of skilled scientists to conduct research in areas of special interest to the National Institutes of Health. Speakers included Drs. Richard Wyatt, Office of the Director, NIH; Bettie Graham, National Human Genome Research Institute; and Clifton Poodry, National Institute of General Medical Sciences.

Dr. Wyatt opened the presentations by explaining that the National Institutes of Health Intramural Program has served for many years as a “training ground” for young investigators. In 1985, the Intramural Research Training effort expanded from a program of summer studies to a one-year program in basic laboratory research for second-year medical students. More recently, the NIH created the Clinical Research Training Program for third-year dental and medical students who have completed their clinical rotations, funded in part by the Pfizer Corporation.

To augment “early recruitment” efforts, the National Institutes of Health added a “curriculum development award” (K30) that provided about \$7 million in fiscal 1998 to 35 institutions. The counterpart at the Intramural program is a course of study entitled “Introduction to the Principles and Practices of Clinical Research,” which has been offered since 1995. The course consists of four modules over several months and is equivalent to about 48 hours of classroom work. “We believe it is important as a part of the training experience, to describe to students and postdoctoral scientists, what is expected and, in turn, to provide mentors with the same information. Then everyone is looking at the training experience in the same way.”

The National Human Genome Research Institute (NHGRI) has had to deal with a slightly different set of issues. This Institute is also actively involved in recruiting experts into health-related research careers. In this case, however, the Institute is looking for a broad array of specialists who can advance research that is highly data oriented. To compete successfully with industry – which also needs experts in the areas of bioinformatics and genomics – the Institute has raised the salary cap of the K01 awards to match the National Institutes of Health salary cap. To determine what other improvements might be needed to keep NHGRI competitive, Dr. Graham conducted an informal survey of specialists in genomic research in 1995. As a result of Dr. Graham’s findings, the Institute developed several new programs to attract and retain skilled researchers. (See Appendix A.) These programs include:

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<sup>17</sup> JL Gordon and DM Kipnis, “Creating the Future: Rather than Simply Reacting to it”, *The Pharos*, vol. 9, p. 13, 1999.

- K01: Individual Mentored Research Scientist Development Award
- K12: Institutional Mentored Research Scientist Development Award
- K22: Genome Scholar and Faculty Transition Award
- K07: Curriculum Development Award in Genomic Research and Analysis
- T15: Short Courses in Genomic Analysis and Interpretation and ELSI Related Research
- T32: NRSA Institutional Training Grant in Genomic Analysis and Interpretation
- F32/F33: NRSA Individual Postdoctoral Fellowship
- F31: NRSA Individual Predoctoral Fellowship Award
- Administrative Supplements

The National Institutes of Health have broadened the range of funds available to universities to prepare skilled specialists in emerging areas of national interest. The NIH Intramural Program, for example, has intensified its role in attracting specialists to clinical research careers. The National Institute of General Medical Sciences has expanded its efforts, furthermore, to recruit underrepresented minorities into biomedical research. Dr. Poodry explained: “To develop the next generation of students, we wanted to support the most effective activities that motivate students. By that we mean that our programs will promote innovation in a competitive environment. We wanted to support activities that develop the potential of these students and to support them in their careers.”

To do that, the National Institute of General Medical Sciences uses a variety of faculty development and fellowship awards. The NIGMS approach to minorities’ recruitment is “institution-centered”. NIGMS gives individuals and institutions the opportunity to “solve the problem” of under-representation. The hallmarks of the NIGMS program are “continual improvement” and “engaging many minds” to address this issue. Dr. Poodry noted: “If we could somehow increase retention, we would double the numbers [of underrepresented minorities] in just a single generation.”

In summary, the speakers from the National Institutes of Health presented a dynamic program of research training and career development. This program has changed significantly in recent years, responding to the unique needs of the health and education communities each Institute serves.

## Other Organizational Perspectives

Many organizations have developed innovative approaches for sustaining talent flow into areas of national interest in science and technology. To broaden the Panel’s understanding of developments in this area, meeting organizers invited a series of speakers. These included: Drs. P. Wynn Jennings, National Science Foundation; Barbara Filner, Howard Hughes Medical Institute; Timothy Ready, Association of American Medical Colleges; Richard Valachovic, American Association of Dental Schools; and Eli Schwarz, American Association for Dental Research.

The National Science Foundation recently launched the “Integrative Graduate Education and Research Training Program” (IGERT). According to Dr. Jennings, the rationale behind the

program is to “really change” graduate education. As a result, the IGERT program encourages proposals that promote:

- Intellectual depth
- Intellectual breadth
- Professional growth experiences
- International awareness and cultural tolerance
- Leadership and teamwork skills
- Communication skills
- Career awareness
- Ethics awareness

As Dr. Jennings pointed out, in the future: “Graduate students will need a new type of resume. They are going to need a resume that talks about their breadth. They are going to need resumes that give them credit for learning a special skill or subject while being in another program.”

The Howard Hughes Medical Institute (HHMI) offers a range of programs to meet the need for “cutting edge” training in the biomedical sciences. Dr. Filner identified a number of elements common to the HHMI graduate and postdoctoral fellowship programs. Awards are made to individuals. Applicants must propose a research plan and have a mentor who participates with them in preparing a plan.

The HHMI award also gives talented students the “flexibility” they need. In addition to the ability to change training sites, this means that: “Fellows are also given the flexibility to shift the emphasis of their research during the course of their fellowship...We think it is very important that, as they proceed with their findings and new technologies become available, they be able to go with the flow.”

The Association of American Medical Colleges (AAMC) is another organization that has responded to the changing landscape of research through focused efforts. Dr. Ready described two themes. First, medical education recognizes the need for new skills and competencies. These include increasing exposure to population medicine and cultural competency. All this is in response to issues of “access” to health care.

Another theme was the specific activities that AAMC has undertaken to increase workforce diversity. These are: (1) the Clinical Research Summit to be convened in November 1999; (2) Project 3000x2000 which is designed to increase the number of minority students in clinical research; and (3) the Health Professions Partnership Initiative, designed to increase diversity and provide a link to enhanced minority health care.

Following the conclusion of Dr. Ready’s remarks, the Panel called upon Dr. Valachovic to discuss programmatic themes at the American Association of Dental Schools. Dr. Valachovic emphasized the idea that dental education and dental schools are a national resource. Dental education is, however, facing a crisis. There are insufficient numbers of faculty to meet the educational needs of students in dental education programs. This crisis was documented by the seminal report, Dental Education at the Crossroads.<sup>18</sup> Dr. Valachovic reviewed the magnitude of the shortage and pointed out that less than one percent of the graduating seniors indicate an interest in pursuing an academic career in dentistry. “We have been working very closely with NIDCR to look for the ‘two percent solution’. If we can get to the point of moving from 0.5

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<sup>18</sup> MJ Field (Ed.), 1995, *op. cit.*

percent to 2 percent of our graduating class, we would be able to address the faculty shortage that we face.”

To address these complex issues, AADS has initiated a number of activities. One key activity was the Task Force on Future Dental School Faculty. The Task Force formulated five recommendations:

1. Collect data to clarify the magnitude of and reasons for faculty shortages and to project faculty shortages for the next decade.
2. Create a set of programmatic activities through AADS to promote academic careers.
3. Promote debt forgiveness and other means of funding for those who pursue education and research careers.
4. Implement culture-changing programs within dental education to mentor, prepare and recruit future faculty.
5. Establish methods for developing, nurturing and retaining faculty.<sup>19</sup>

Speaking for the American Association for Dental Research, Dr. Schwarz acknowledged that the foundations of dental science have changed dramatically during the last decade. “It is absolutely clear at this point that the focus for dental science included post-genomic research, biomimetics and tissue engineering, translational research, entirely new clinical and epidemiological research, and strategic new partnerships involving all parts of the dental care delivery system in the United States.”

Dr. Schwarz underscored the need to expand training efforts to include “re-training” for the existing dental and craniofacial research communities. “While we are creating a new pipeline of individuals for future research, we must convert the existing human resource to a contemporary one that is competitive on all fronts. NIDCR and AADR both have major roles to play here.”

### The Meyerhoff Scholarship Program

On the morning of the second day of the Blue Ribbon Panel meeting, Dr. Freeman A. Hrabowski, III, President of the University of Maryland at Baltimore County, addressed the group. Dr. Hrabowski described the campus and discussed the steps taken through the Meyerhoff Scholarship program to create an atmosphere that encourages historically underrepresented students to pursue a scientific career.

Dr. Hrabowski described the key components of the Meyerhoff Program. The emphasis of the Meyerhoff Scholars Program has been on producing PhDs. The first half million dollars for the program came from Robert Meyerhoff, a philanthropist in the Baltimore area. Much of the support beyond the private funding has come from both NIH (MARC) and NSF (Alliance for Minority Participation). The Meyerhoff Program connects students with active researchers literally from their freshman year and certainly after the freshman year. These faculty work with them in laboratories, get to know them and give them a chance to feel their enthusiasm for science.

While it is difficult to capture the complexity of the program, the key components include the following strategies:

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<sup>19</sup> American Association of Dental Schools, Report of the Task Force on Future Dental School Faculty, Office of the Executive Director, Washington, DC, 1999.

1. Recruit culturally diverse top math and science students.
2. Provide a summer bridge program.
3. Provide four years of comprehensive scholarships.
4. Encourage the formation of study groups among students.
5. Emphasize program values.
6. Create a program community -- a family-like, campus-based community.
7. Provide full time personal advisers and counselors.
8. Offer tutoring.
9. Create a network of contact to arrange for summer research internships.
10. Involve faculty at all levels in the program of recruitment and training.
11. Involve administrators at the highest level on campus and in the public to support the program.
12. Provide mentors for each student from the professions.
13. Keep parents involved in the academic and personal progress of each student.

The program is still relatively small. There were about 200 students enrolled in the program in 1999. Research has shown, however, that the Meyerhoff model is very effective. Numerous graduates have entered PhD programs; some have already moved to the dissertation level.<sup>20</sup> Furthermore, all students who entered medical school have completed their degrees. Clearly, the Meyerhoff Scholarship Program represents an effective technique for attracting and retaining high achieving minorities in research careers.

## Perspectives from the Extramural Research Community

Research training program directors and individuals engaged in research training provide valuable insights into career formation as we approach the 21<sup>st</sup> Century. Meeting organizers arranged for three trainees and four program directors to describe contemporary issues. Their testimony is presented in detail in Appendix A.

Three individuals having received research training and career development support from the NIDCR provided helpful insights into the training process. Dr. Sylvia Frazier-Bowers explained that she hopes to become “an academician who uses molecular research tools to answer clinical questions, while maintaining clinical and teaching activities.” Ms. Jeanne Nervina also plans to enter a career in “academic dentistry.” Like her colleagues, Ms. Nervina recognizes that dental scientists of the “near future” must be well prepared in their discipline of training but ready to “be a part of a highly integrated scientific team.” Dr. Peg Nopoulos extended this idea of “teamwork” by pointing out that the mutual training of clinicians and basic scientists “facilitates collaborative research.”

Besides the emerging importance of team approaches to science, another theme that emerged during the presentations by the trainees was that a “translational research experience” needs to be

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<sup>20</sup> See, for example, FA Hrabowski III and W. Pearson, Jr., “Recruiting and Retaining Talented African-American Males in College Science and Engineering”, *JCST*, February 1993, pp. 234 – 238; and FA Hrabowski III and KI Maton, “Enhancing the Success of African-American Students in the Sciences: Freshman Year Outcomes”, *School Science and Mathematics*, vol. 95, pp 18 – 27, 1995.

“integrated” into existing programs. Some of the speakers reported competing demands on their time but also a lack of appreciation within the academic community for the goal of integrating dental research with teaching and delivery.

Subsequently, directors from the training program community echoed this sentiment. Dr. Freddie Jordan, Director, Short-Term Research Training Program, The Ohio State University College of Dentistry, noted that it is essential to extend the research experience beyond the short-term training program she directs. But many schools do not foster an environment that permits the integration of research into health care education and delivery.

Dr. Mark Herzberg, Director, Dentist Scientist Program, University of Minnesota School of Dentistry, suggested that NIDCR might need to maintain a more flexible training portfolio. Such a portfolio might include separate programs for basic research training and for clinical research training with multiple points of entry. Dr. Herzberg also noted that there seemed to be a lack of visibility of the NIDCR research training programs that resulted in a lower number of applications for training support than might be expected by virtue of the exciting new research opportunities on the horizon.

Dr. Paul Dechow, Director, NRSA Institutional Training Program, Baylor College of Dentistry, reported that postdoctoral research training programs seemed to reflect the new directions of oral health research. A poll of training program directors revealed research training opportunities in such fields as oral biology, epidemiology, neuroscience, dental materials, craniofacial research as well as behavioral sciences and dental informatics.

Dr. Alan Lurie, Director, Dental Scientist Training Program, University of Connecticut School of Dental Medicine, reinforced the comments of several of the speakers by suggesting that the Panel address the “environment” in dental clinical sciences. “The DSTP-supported DMD/PhD Program is a new but potentially very effective vehicle to help meet the future training needs for oral health research and academic dentistry. Trainees enter a career of combined research and clinical activity at a time when academic dentistry is sorely in need of such individuals. DSTP trainees will have balanced training in primary dental care and in research, and as such will be in an ideal position to provide research excellence and multidisciplinary clinical and research leadership to the nation’s dental schools. Issues of recruitment, curricular design, quality of trainee life and education experience, post-DSTP training, outcome assessment, and program funding are issues which need further assessment and adjustment.”

In summary, a number of organizations – including the National Institute of Dental and Craniofacial Research – have in recent years introduced innovative and effective strategies for attracting talented individuals to careers in science and then giving them the training and development that they need to enter productive employment. However, there are profound challenges in the health and health professions education sectors that must be addressed if the dental, oral, and craniofacial research communities are to have access to the talent that is needed to advance research in those areas in the coming years. In addition, the Blue Ribbon Panel developed a series of specific recommendations that are described in the next chapter.